

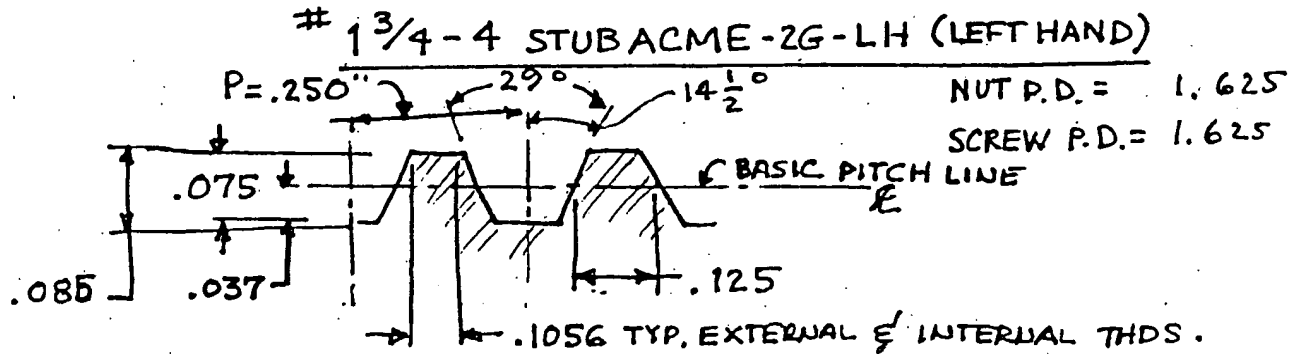
EXHIBIT D

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PROCTOR DEVELOPMENT- ENGINEERING SKETCH
 ANCHOR TIEDOWN SYSTEMS, INC.
 POWER MODULE - FOR UP TO 1" DIA. TIE RODS

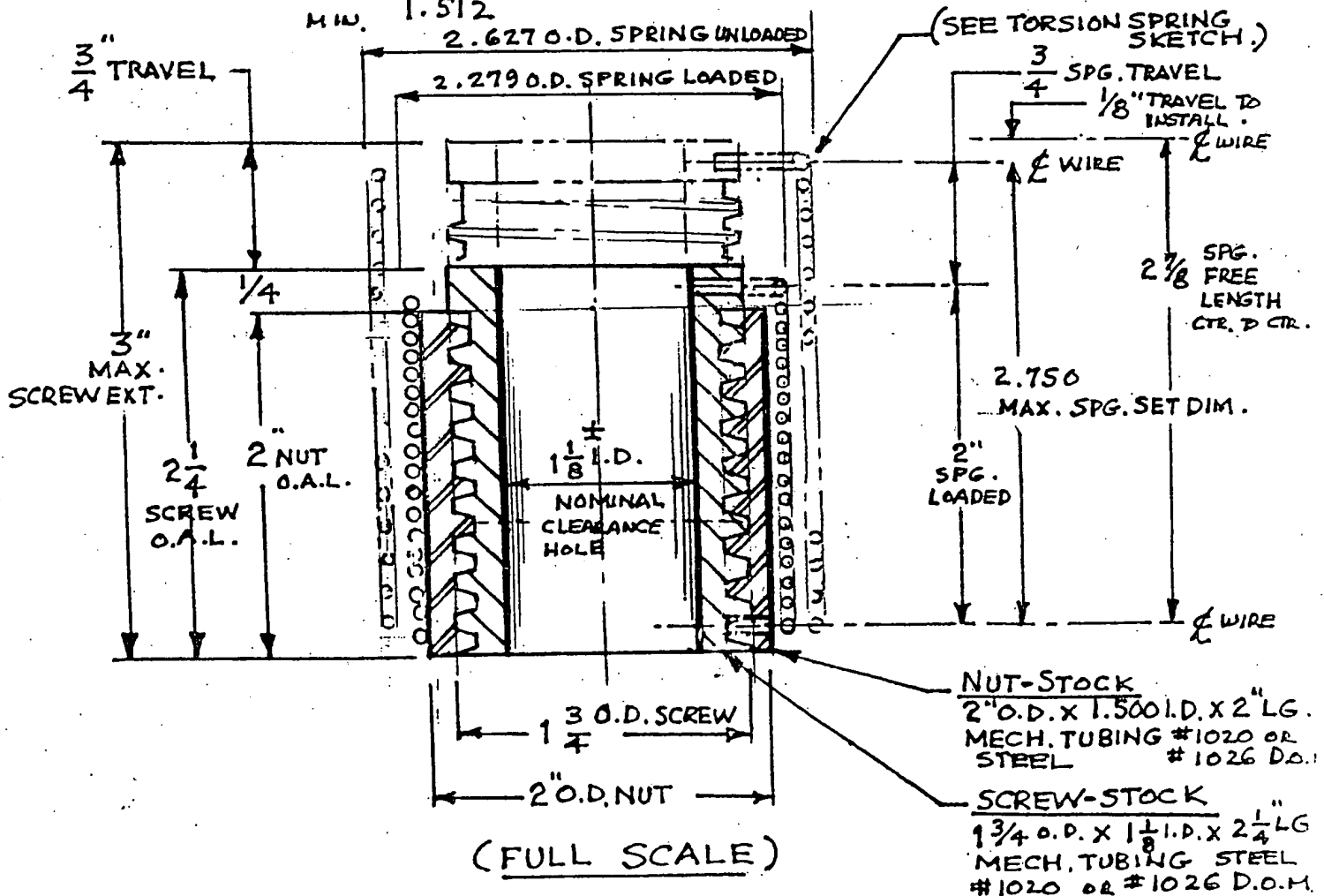
APR 14 1998
 TUESDAY
 D. Hanna

(CLASS 2G) STUB ACME THREADS - PROFILE DIMENSIONS



MAJOR DIA. = 1.750 EXTERNAL THREADS (SCREW)
 (MAX.)
 (MIN.) 1.737

MINOR DIA. = 1.500 INTERNAL THREADS (NUT)
 MAX.
 MIN. 1.512



APR 15 1998

By D. LemayTORSION SPRING CALCULATIONS - ANCHOR TIE DOWN SYSTEMS, INC.

L.H. WOUND SPRING - 24# FORCE

1.) FOR PRELOADED SPRING $360^\circ \times 3$ TURNS = 1080°

2.) SPRING I.D. DECREASED AFTER LOADING:

N = No COILS (18)
REVS. = 3 LEG
REVOLUTIONS

$$I.D. = \frac{N}{N+REV} \times I.D. (UNLOADED) 2.437 I.D.$$

$$I.D. = \frac{18}{18+3} \times 2.437 = (.8571) \times 2.437 = 2.089 I.D. \quad \text{LOADED}$$
$$2.279 O.D. \quad \text{LOADED}$$

3.) @ 24# FORCE, THEORETICAL WIRE DIA. REQ'D. (d):

d = WIRE DIA.

S_b = 150,000 PSI

P = 24# ±

R = LENGTH OF TORQUE
ARM .725" ±

$$d = \sqrt[3]{\frac{10.2 \times PR}{S_b}} = \sqrt[3]{\frac{10.2 \times 24 \times .725}{150,000}} = .106 \phi$$

(WILL USE .095
DIA. WIRE.)
STATIC CONDITION

33(.095) GA. MUSIC WIRE.

SAE # 1085, SAE # 1090
ASTM A228-51

4.) STRESS @ 24#^(±) LOAD (S_b):

$$S_b = \frac{10.2 PR}{d^3} = \frac{10.2 \times 24 \times .725}{.000857} = 2,07,095 \text{ P.S.I.}$$

(OVERSTRESSED BUT STATIC
LOADED)

5.) NUMBER OF ACTIVE COILS (N):

E = 30,000,000 E-MOD
TENSION

P = 24#

F° = $360^\circ \times 3 \text{ REVS} = 1080^\circ$

D = 2.089 + .095 = 2.184

d⁴ = .095⁴ = .00008145

$$N = \frac{E d^4 F^\circ}{4000 PRD} = \frac{30,000,000 \times .00008145 \times 1080^\circ}{4000 \times 24 \times .725 \times 2.184}$$

$$N = \frac{2638980}{152006} = 17 \text{ ACTIVE COILS}$$

18 TOTAL

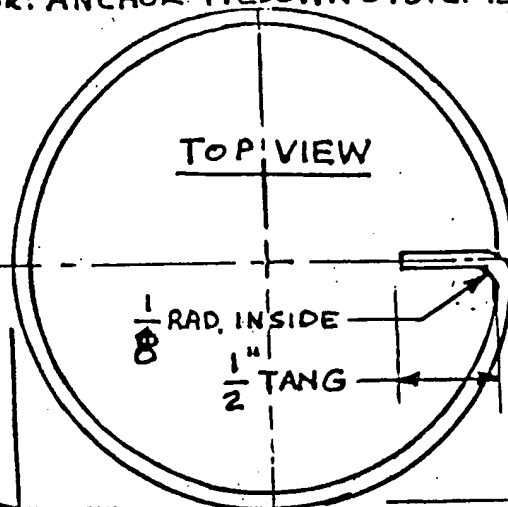
TORSION SPRING - ENGINEERING SKETCH

(FULL SCALE) FOR: ANCHOR TIEDOWN SYSTEMS, INC.

APR 16 1998
W. Lemon

POWER MODULE
 SPRING

NOTE:
LEFT HAND
WOUND -



24[#] FORCE LOADED
 (3-REVOLUTIONS)

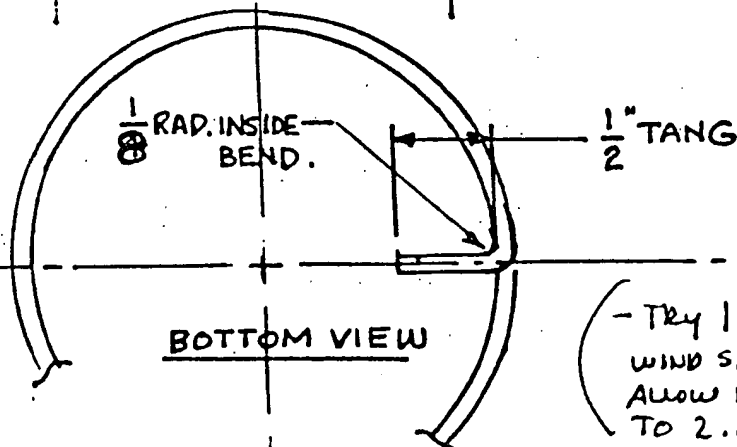
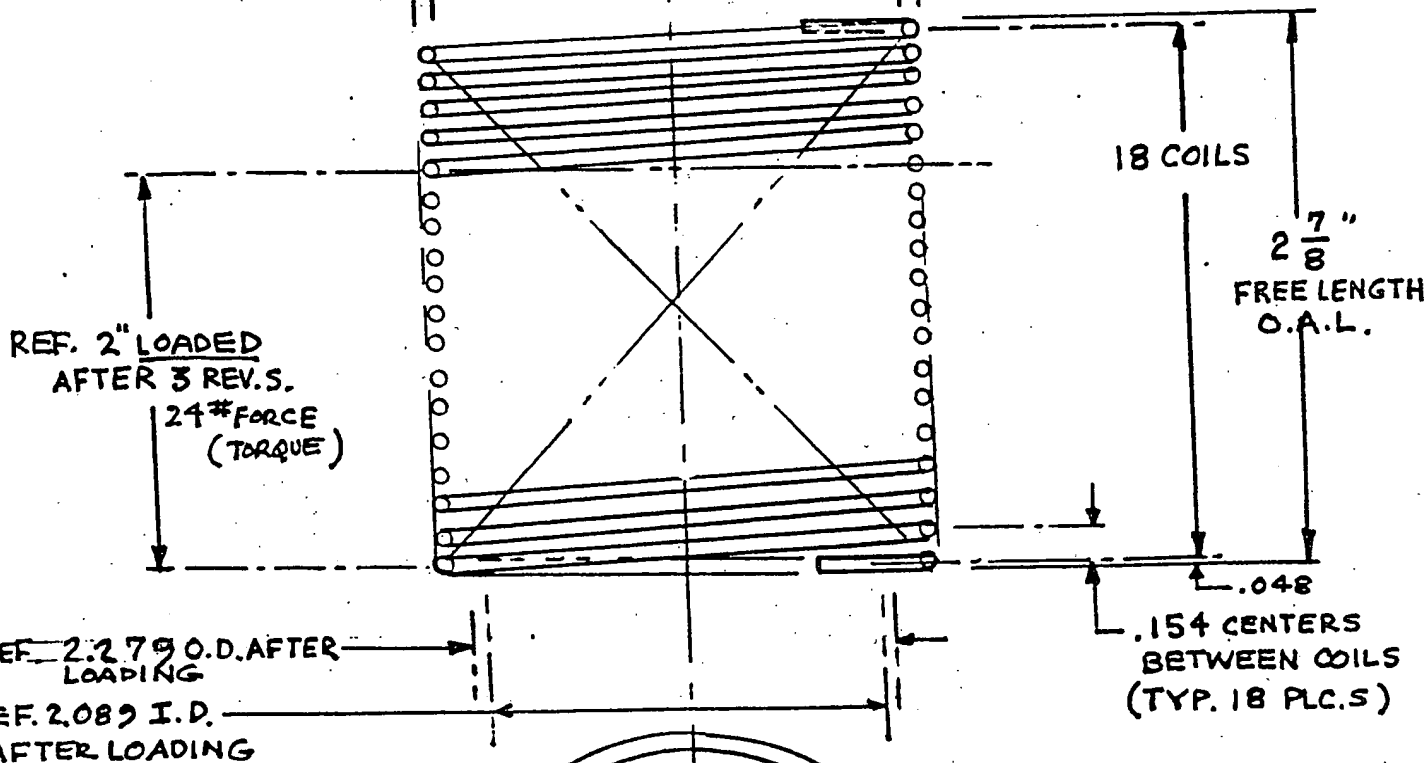
OPTION
 O.K.

"McMASTER-CARR"
 #34 (.094) GA.
 #9666K47

MAT'L: #33 (.095) GA.

MUSIC WIRE
 SAE #1085 OR
 SAE #1090

STRAIGHT LENGTH 13'-0"
 W/CUT-OFF ALLOWANCE.



PRELIMINARY

- TRY $\frac{1}{8}$ " Ø ARBOR TO
 WIND SPRING THIS WILL
 ALLOW FOR SPRING BACK
 TO 2.627 O.D. DIM.

PROCTOR DEVELOPMENT

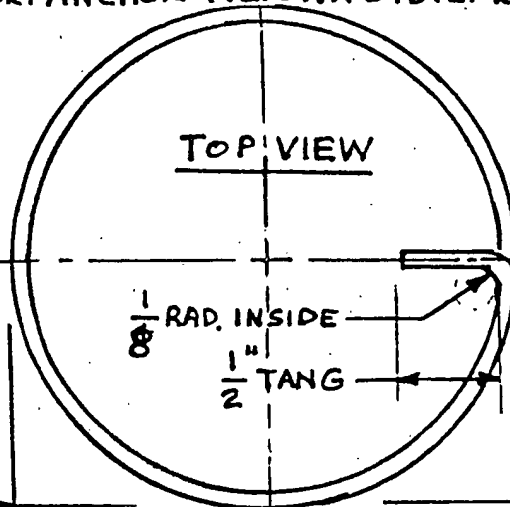
TORSION SPRING - ENGINEERING SKETCH (FULL SCALE) FOR: ANCHOR TIEDOWN SYSTEMS, INC.

APR 16 1998

W. Lemon

POWER MODULE
SPRING

NOTE:
LEFT HAND
WOUND -



24[#] FORCE LOADED
(3 - REVOLUTIONS)

OPTION
O.K. ["MCMASTER-CARR"
#34 (.094) GA.
#9666K47]

MAT'L: #33 (.095) GA.

MUSIC WIRE

SAE #1085 OR

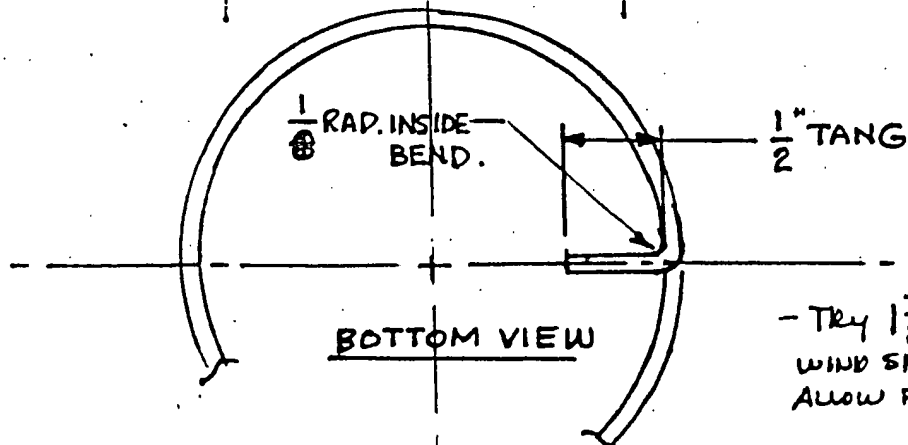
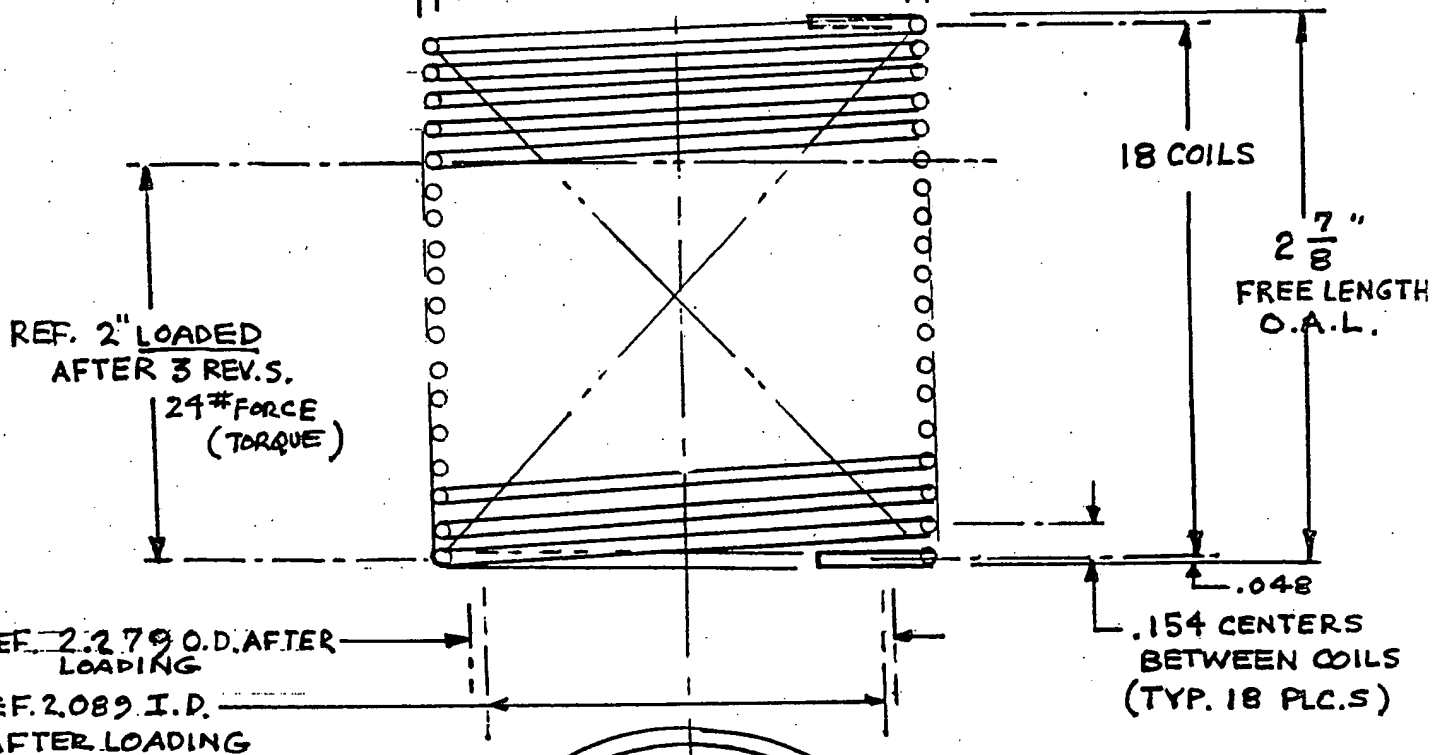
SAE #1090 "

STRAIGHT LENGTH 13'-0"
W/CUT OFF ALLOWANCE.

2.627
O.D. AS
WOUND

2.437 I.D.

.095 DIA. WIRE



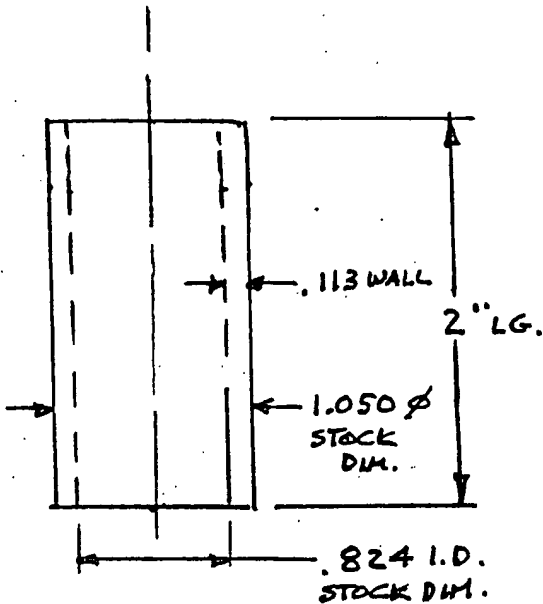
- TRY $1 \frac{7}{8}$ ϕ ARBOR TO
WIND SPRING THIS WIRE
ALLOW FOR SPRING BACK

PROCTOR DEVELOPMENT

SLEEVE ADAPTER - POWER MODULE
FOR ANCHOR TIE DOWN SYSTEMS, INC.

APR 16 1996
R. Leman

3/4" ϕ TIE ROD ADAPTER -



MAT'L - 3/4" DIA. NOM. (SCH. 40) PIPE
GALV. STEEL X 2" LG.

FOR: ANCHOR TIEDOWN SYSTEMS, INC.

APR 16 1998

L. Lemon

STRENGTH OF # 1 3/4 - 4 STUB ACME THREADS

USING # AISI 1026 D.O.M. MECHANICAL STEEL TUBING.

E = MAX. PITCH DIA.

1.) $ES = (E = 1.750 - 0.5P = 1.750 \text{ DIA.} - .125 = 1.625 - .0105 = \underline{1.615} = E \text{ MAX P.D.}$
 $KS = \frac{ES = .00794 - 1.615 = 1.607 = ES}{K = D - P = 1.5 \text{ BASIC MINOR DIA. } 1.5 - 1.5 \times 1.5125} \quad KS = \underline{1.468}$
 $KN =$

$P = \text{PITCH } 1 \div 4 \text{ THRS/IN} = .25$

$D = 1.750"$

1A. STRESS AREA = $\pi \left(\frac{ES + KS}{4} \right)^2 = 3.1416 \left(\frac{1.607 + 1.468}{4} \right)^2$

$= \underline{1.857} \text{ STRESS AREA (At)}$

1B. SHEAR AREA = $\pi KN \left[0.5 + \frac{1}{P} \tan 14\frac{1}{2}^\circ (ES - KN) \right]$

$ES = 1.5916$

$3.1416 \cdot 1.5125 \left[0.5 + \frac{1}{.25} \times .258617584 (1.5916 - 1.5125) \right]$
 $(.0791)$

$= 4.75166 [.08263] = \underline{.393} \text{ SHEAR AREA}$

2.) AISI 1026 STEEL = TENSILE: 55,000 PSI (S)

YIELD : 30,000 PSI

[THIS POWER MODULE
WILL SUPPORT 51.0 KIPS
BEFORE FAILING. (102,135#)
MEETS CRITERIA.]

P = LOAD TO BREAK THREADED PORTION OF
SCREW IN TENSION/COMPRESSION

$P = S A_t = 55,000 \times 1.857 = \underline{102,135 \text{ LBS}}$

51 TONS

PER KENNETH & ARTHUR OF
"ANCHOR TIEDOWN SYSTEMS" LOAD REQUIREMENTS:

FOR: 3/8, 1/2, 5/8, 3/4 & 1" = 20.94 KIPS (OR 41,880#)
(TIE ROD DIAMETERS)

@ 51 KIPS = 2.44 SAFETY FACTOR
OK.

FOR 1 1/8 TO 1 1/4" = 31.5 KIPS (63,000#)
(TIE ROD DIAMETERS)

(A LARGER POWER MODULE IS REQ'D
TO FIT THESE LARGER TIE ROD DIAMETERS.)

PROCTOR DEVELOPMENT

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